


FORM PTO 1390 (REV 5-93) US DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE		ATTORNEY DOCKET NUMBER 2002-0441A
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. §371		U.S. APPLICATION NO. (if known, use 37 CFR 1.5) [NEW] 107089437
International Application No. PCT/NO00/00345	International Filing Date October 18, 2000	Priority Date Claimed October 18, 1999
Title of Invention METHOD AND USE OF CALCIUM NITRATE FOR FOAMING OF STEEL-MAKING SLAGS		
Applicant(s) For DO/EO/US Petter TUVNES; Torvald Abel ENGH		
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:		
1. <input checked="" type="checkbox"/> This is a FIRST submission of items concerning a filing under 35 U.S.C. §371. 2. <input type="checkbox"/> This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. §371. 3. <input checked="" type="checkbox"/> This express request to begin national examination procedures (35 U.S.C. §371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. §371(b) and PCT Articles 22 and 39(1). 4. <input checked="" type="checkbox"/> A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date. 5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. §371(c)(2)) a. <input checked="" type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau). ATTACHMENT A b. <input type="checkbox"/> has been transmitted by the International Bureau. c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US) 6. <input type="checkbox"/> A translation of the International Application into English (35 U.S.C. §371(c)(2)). 7. <input type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. §371(c)(3)). a. <input type="checkbox"/> are transmitted herewith (required only if not transmitted by the International Bureau). b. <input type="checkbox"/> have been transmitted by the International Bureau. c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired. d. <input type="checkbox"/> have not been made and will not be made. 8. <input type="checkbox"/> A translation of the amendments to the claims under PCT Article 19. 9. <input checked="" type="checkbox"/> An unexecuted oath or declaration of the inventor(s) (35 U.S.C. §371(c)(4)). ATTACHMENT B 10. <input checked="" type="checkbox"/> A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. §371(c)(5)). ATTACHMENT C Items 11. to 14. below concern other document(s) or information included: 11. <input checked="" type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98. ATTACHMENT D 12. <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included. 13. <input checked="" type="checkbox"/> A FIRST preliminary amendment. ATTACHMENT E <input type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment. 14. <input checked="" type="checkbox"/> Other items or information: a. Cover Page of Published International Application No. WO 01/29271 - ATTACHMENT F b. International Search Report - ATTACHMENT G c. Norwegian Search Report - ATTACHMENT H		

U.S. APPLICATION NO. (if known, see 37 CFR 1.5) [NEW] 10/089437		INTERNATIONAL APPLICATION NO. PCT/NO00/00345		ATTORNEY'S DOCKET NO. 2002-0441A	
15. <input checked="" type="checkbox"/> The following fees are submitted				CALCULATIONS	
BASIC NATIONAL FEE (37 CFR 1.492(a)(1)-(5)): Neither international preliminary examination fee nor international search fee paid to USPTO and International Search Report not prepared by the EPO or JPO \$1040.00 International Search Report has been prepared by the EPO or JPO \$ 890.00 International preliminary examination fee not paid to USPTO but international search paid to USPTO \$ 740.00 International preliminary examination fee paid to USPTO but claims did not satisfy provisions of PCT Article 33(1)-(4) \$ 690.00 International preliminary examination fee paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) \$ 100.00				\$1,040.00	
ENTER APPROPRIATE BASIC FEE AMOUNT =					
Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(e)).					
Claims	Number Filed	Number Extra	Rate		
Total Claims	11 -20 =	0	X \$18.00		
Independent Claims	3 - 3 =	0	X \$84.00		
Multiple dependent claim(s) (if applicable)			+ \$280.00		
TOTAL OF ABOVE CALCULATIONS =				\$1,040.00	
<input type="checkbox"/> Small Entity Status is hereby asserted. Above fees are reduced by 1/2.					
SUBTOTAL =				\$1,040.00	
Processing fee of \$130.00 for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				+	
TOTAL NATIONAL FEE =				\$1,040.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40 per property +					
TOTAL FEES ENCLOSED =				\$1,040.00	
				Amount to be refunded	\$
				Amount to be charged	\$
a. <input checked="" type="checkbox"/> A check in the amount of \$ <u>1,040.00</u> to cover the above fees is enclosed. A duplicate copy of this form is enclosed. b. <input type="checkbox"/> Please charge my Deposit Account No. 23-0975 in the amount of \$ _____ to cover the above fees. A duplicate copy of this sheet is enclosed. c. <input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. <u>23-0975</u> .					
NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.					
19. CORRESPONDENCE ADDRESS <div style="text-align: center;">  000513 PATENT TRADEMARK OFFICE </div>			By: <u>Matthew Jacobb</u> Matthew Jacobb, Registration No. 25,154 WENDEROTH, LIND & PONACK, L.L.P. 2033 "K" Street, N.W., Suite 800 Washington, D.C. 20006-1021 Phone: (202) 721-8200 Fax: (202) 721-8250 March 29, 2002		

THE COMMISSIONER IS AUTHORIZED
 TO CHARGE ANY DEFICIENCY IN THE
 FEE FOR THIS PAPER TO DEPOSIT
 ACCOUNT NO. 23-0975.

[CHECK NO. 49553]
 [2002-0441A]

107089437

IC10 Rec'd PCT/PTO 29 MAR 2002

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of :
Petter TUVNES et al. : Attn: BOX PCT
Serial No. [NEW] : Docket No. 2002-0441A
Filed March 29, 2002 :
METHOD AND USE OF CALCIUM :
NITRATE FOR FOAMING OF STEEL- :
MAKING SLAGS :
[Corresponding to PCT/NO00/00345 :
Filed October 18, 2000]

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents,
Washington, DC 20231

Sir:

In the interest of compact prosecution and to reduce PTO filing fees, please amend the present application as follows:

IN THE CLAIMS:

Please amend claim 5 as follows:

5. (Amended) Method according to claim 1, wherein the ratio between calcium nitrate and carbon is in the range from 4:1 to 2:1.

Please add the following new claims:

9. (New) Method according to claim 2, wherein the ratio between calcium nitrate and carbon is in the range from 4:1 to 2:1.

10. (New) Method according to claim 3, wherein the ratio between calcium nitrate and carbon is in the range from 4:1 to 2:1.

ATTACHMENT E

REMARKS

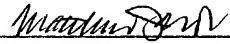
The above amendment is presented to eliminate multiple dependent claims, thereby reducing PTO filing fees.

Attached hereto is a marked-up version of the changes made to the claims by the current amendment. The attached page is entitled "**Version with Markings to Show Changes Made**".

Favorable action on the merits is now requested.

Respectfully submitted,

Petter TUVNES et al.

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March 29, 2002

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS:

Claim 5 has been amended as follows:

5. (**Amended**) Method according to claim 1 [-4], wherein the ratio between calcium nitrate and carbon is in the range from 4:1 to 2:1.

IC10 Rec'd PCT/PTO 29 MAR 2002

**METHOD AND USE OF CALCIUM NITRATE FOR FOAMING OF
STEEL-MAKING SLAGS**

The invention concerns a method of foaming steel-making slags and a use of calcium nitrate as a slag foaming agent in steel-making.

The use of electric arc furnaces, converters and ladles in steelmaking are techniques well-known to those skilled in the steelmaking profession, ref. T. Abel Engh; "Principles of Metal Refining", Oxford Science Publications, ISBN 0-19-856337-X, (1992).

The electric arc process differs from other steelmaking processes in its use of scrap steel as most of the charge. The scrap is added to the furnace at the beginning of the process cycle and melted down by the passage of electric current through the furnace's graphite electrodes. Slag formers are added during melt down, in order to protect the melt from oxidation. A slag is formed on the surface of the charge during the initial melt-down, which remains during the entire process cycle until tapping of the heat. The composition of the slag layer will be dependent on the impurities in the melt and on further additions to the melt. After melting, the steel is transferred to converters and ladles.

In the latest years steel producers have made an effort in obtaining good methods for creation of foaming slags, as these give several process advantages. A foaming slag will give better insulating properties meaning less heat loss from an electric arc furnace. The refractories and electrodes are protected from arc radiation which means increased lifetime, and the sound is muffled. The electric arc is stabilised and it is possible to increase the power input, giving increased productivity. Different slag foaming methods and agents are thus described in the literature.

From US patent No. 4 528 035 it is known a method of foaming the slag generated in a steel making electric arc furnace after melt-down of steel raw material by introducing a foaming agent comprising essentially of calcium oxide (CaO) and free carbon (C) particles when the amount of said slag atop said melted steel is at least 4 inches deep.

US patent No. 4 447 265 describes a slag-foaming composition and process for use in electric arc furnace steel-making. The compositions comprise from about 15 to 80 wt % of a carbon source, the remainder consisting substantially of a source of an oxide of calcium; alternatively, the compositions comprise from about 15 to 30 wt % of a carbon source, the remainder consisting substantially of dolomite lime. The process consists of the addition, in the course of steelmaking using an electric arc furnace, of the steelmaking additive compositions of the invention to the charge subsequent to the initial scrap steel melt down.

From FR 2 634 787 it is known a method for the production of a foaming slag by blowing oxygen close to the metal-slag interface and by the addition into the slag of a carbonised material previously mixed with a carbonate material such as limestone or dolomite.

From JP08041521 it is known that foaming of a slag in a ladle can be achieved by adding lime nitrogen having C source (CaCN) from above the melt thereby causing the slag volume to increase in such a way that deslagging of the ladle is more efficient.

Stainless steel slags are difficult to foam and it has only recently been able to develop reliable methods for creating foaming slags in the arc furnace. Such a method is described in Masucci, P., Capodilupo, D., Brascugli, G. (1993), "Foaming slags for stainless steel smelting in the electric arc furnace," Electric Furnace Proceedings, pp 289-294. Limestone, CaCO_3 , and coke have been added to give foaming. Special ovules have been used to promote a closer contact between limestone and coke. These are composed of a mix of limestone and metallurgical coke (with a C content of 87 %) with grains measuring 0.5 to 1 mm and bound with starch. The ratio of graphite and limestone is 50/50. Slag foaming was achieved by blowing large quantities of oxygen and adding the limestone-coke ovules.

For current slag foaming processes for stainless steel-making, the composition range of the slag has to be very narrow in order to achieve proper foaming. Another disadvantage is that an unacceptable amount of the alloying element Cr is oxidised to Cr_2O_3 and lost

in the slag, ref. M. Görnerup, Doctoral Thesis "Studies of Slag Metallurgy in stainless Steelmaking", ISBN 91-7170-205-9 (1997).

The object of the invention is to find other efficient foaming agents and especially agents that produce foam in stainless steel slags. Another object is to avoid the disadvantages with earlier known agents.

These and other objects of the invention are obtained by the process as defined in the patent claims.

The invention thus concerns a method of foaming steel-making slags, wherein calcium nitrate is added to the slag together with carbon. Calcium nitrate and carbon can be fed into the slag, with injection gases such as air, carbon dioxide or inert gases. The solid components can be injected separately or with the same lance or injected as pre-fused granules. For ladle slag foaming calcium nitrate and carbon is added from above the melt. It is preferred to use a ratio between calcium nitrate and carbon in the range from 4:1 to 2:1. For foaming of stainless steel slag, it is preferred to add FeSi, Al or Mg before calcium nitrate and carbon is added or injected into the slag by an injection gas. Air, carbon dioxide or inert gases can be used as injection gases. The invention also concerns the use of calcium nitrate as a foaming agent for steel-making slags. The invention can be used for slag foaming in electric arc furnaces and ladles.

We have found that calcium nitrate is an efficient foaming agent for steel-making slags, especially for stainless steel.

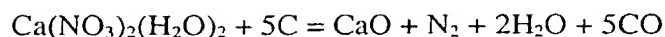
Bubbles are formed when a gas is introduced into a slag. Bubbles on top of the foam rupture and decay. At steady state the liquid carried upwards as a thin film separating the bubbles is balanced by the downward flow of liquid released by the top rupturing process. For a given slag the height of the foam increases with the gas flow rate. If the gas flow stops, the films become thinner as they drain. Then the bubbles rupture when a critical film thickness is reached.

Foaming of low alloy steel slags

For low alloy steel-making slags, foam today is produced by two main routes that both require that carbon and oxygen react to CO:

- a) Injected oxygen in the steels reacts with iron oxide that ends up in the slag. In the following step the iron oxide is reduced by injected carbon and CO gas is formed. Carbon dissolved in the steel may also contribute to gas production.
- b) Carbon (injected in the slag or dissolved in the steel) and injected oxygen react directly to give CO.

Doubtless, other gases than CO can give foaming. Thus, calcium nitrate together with carbon at steel-making temperatures reacts as follows:



Due to the high partial pressure of oxygen and the presence of iron and CaO, a Fe_2O_3 -CaO slag is formed.

Use of calcium nitrate as an agent for producing a foaming slag in the electric arc will serve the triple objective of adding lime to increase the basicity of the slag (for removal of P and S), supplying gaseous components N_2 and H_2O to promote foaming and O_2 for the reaction with the injected carbon, giving CO which also promotes foaming. The calcium nitrate, mixed with carbon, could be added through chutes or injected by a gas or air into the slag through a lance. The calcium nitrate may be used with or without various amounts of crystal water $\text{Ca}(\text{NO}_3)_2(\text{H}_2\text{O})_x$ (where $x = 0-3$). Various small amounts of other elements may also be present, e.g. ammonium etc.

Calcium nitrate is particularly interesting in cases where nitrogen in steel is beneficial as in austenitic stainless steel, where it improves pitting resistance and strength. Also in some unalloyed/low alloyed steels, nitrogen will increase strength and hardenability.

Foaming of stainless steel slag

Normally a stainless steel contains 12-30 % Cr and other elements of which Ni and Mo are the most important. The necessity of removing carbon to low levels in the presence of chromium determines the special character of stainless steel-making.

The most common route for stainless steel-making today is to melt low alloy or stainless scrap, and ferro-alloys in an electric arc furnace. The decarburization, recovery of Cr from the top-slag by reduction, sulphur removal and adjustment of the steel composition is carried out in a converter.

For stainless steels one has only recently been able to develop reliable methods for creating a proper foaming slag in arc furnaces. The reason seems to be some subtle effects caused by the Cr_2O_3 content of the slag. The Cr_2O_3 has a low solubility in electric arc furnace slags and some of it remains as a solid second phase. This chromium oxide reacts very slowly with carbon to give CO and to recover the Cr.

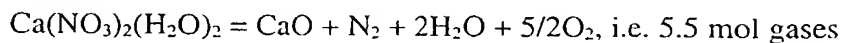
Since Cr_2O_3 is unwanted in a foaming slag, it is suggested that CO-foaming in stainless steel slag is generated involving the metal phase as little as possible. First, FeSi or Al or Mg should be added to prevent the oxidation of Cr and to reduce the Cr_2O_3 -content in the slag, and thereafter calcium nitrate and carbon should be injected carefully into the slag. The solid components are injected separately or with the same lance, or injected as pre-fused granules.

The invention will be illustrated by the following examples:

The technical grade calcium nitrate available on the market (for example Nitcal® from Norsk Hydro ASA) has a chemical composition close to $\text{Ca}(\text{NO}_3)_2(\text{NH}_4\text{NO}_3)_{0.2}(\text{H}_2\text{O})_2$ and has the form of granules with a diameter of about 2 - 4 mm. If mixed with a carbon source, this source should have the form of a powder. The mixing ratio of calcium nitrate to carbon should be in the range from 4:1 to 2:1.

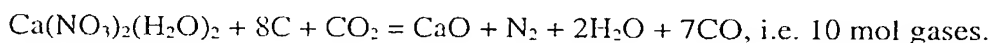
Various processes are possible:

1) Addition of calcium nitrate alone or injection by gas (inert gas, air or CO₂) that will stir the slag. Calcium nitrate will mainly decompose to CaO slag and O₂, N₂, H₂O gases:



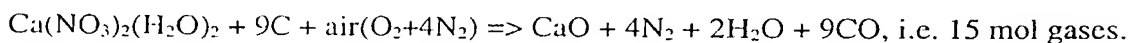
1 kg calcium nitrate (ca. 5 mol) may give about 27.5 mol gases = 0.616 Nm³ of gases.

2) Injection of calcium nitrate + C by CO₂ will give CaO slag and N₂, H₂O, CO gases:



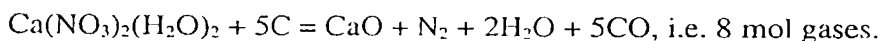
1 kg calcium nitrate + 0.48 kg C + 0.22 kg CO₂ => 50 mol gases = 1.1 Nm³ gases.

3) Injection of calcium nitrate + C by air will give CaO slag and N₂, H₂O, CO gases:



1 kg calcium nitrate + 0.54 kg C + 0.72 kg air => ca. 75 mol gases = 1.7 Nm³ gases.

4) Injection of calcium nitrate + C by nitrogen or inert gas will give CaO slag and N₂, H₂O, CO gases:



1 kg calcium nitrate + 0.3 kg C => ca. 40 mol gases = 0.9 Nm³ gases.

Ca. 0.05 kg (0.04 Nm³) nitrogen per kg calcium nitrate is necessary as injection gas.

Example

Demonstration tests have been carried out. About 1.5 kg of stainless steel type AISI 302 was melted in a crucible by a gas flame. After melting, about 0.3 kg calcium nitrate, Nitcal ®, was poured on top of the melt. The high temperature of the melt and crucible caused the calcium nitrate to melt, decompose and react by evolving gases which bubbled out of the molten calcium nitrate and created a foam. The decomposition periode took about 2 minutes after the calcium nitrate had been added, and converted the calcium nitrate to a foamy substance with about 2-3 times volume increase.

Full scale testing of Nitcal® in an EAF with the purpose to observe the behaviour and foaming potential of Nitcal® has been conducted. Up to 300 kg Nitcal® per melt (3,5 kg Nitcal/ton steel) was injected by air into the melt simultaneously with separate carbon injection. No dramatic reactions occurred despite the crystal water content in Nitcal®. The tests showed that Nitcal® is easy to handle and inject into the melt of an EAF by simple and standard injection equipment. Gas evolution and reaction with C was observed. Injection by air will give oxidising conditions that will increase the level of Cr_2O_3 in the slag. Injection of Nitcal® together with C in such a way that the oxygen in Nitcal® reacts with C to CO does not increase the NO_x level from the EAF. The result of the tests in the EAF showed that Nitcal® should be injected into the melt by nitrogen together with sufficient amount of carbon (1 kg Nitcal® requires 0,3 kg C) in order to achieve reducing conditions and reduced loss of Cr to the slag.

The total foam height that is wanted, may be achieved by adding various amounts of calcium nitrate. Compared to current practice, about 10 kg of calcium nitrate per ton steel charge must be added in order to achieve the same amount of gas evolution as typical for current practices.

Patent claims

1. Method of foaming steel-making slags, wherein calcium nitrate is added to the slag alone or together with carbon.
2. Method according to claim 1, wherein calcium nitrate alone or mixed with carbon is injected into the slag with injection gases such as air, nitrogen, carbon dioxide or inert gases.
3. Method according to claim 2, wherein the solid components are injected separately or with the same lance or injected as pre-fused granules.
4. Method according to claim 1, wherein calcium nitrate alone or mixed with carbon is added from above the melt.
5. Method according to claim 1 -4, wherein the ratio between calcium nitrate and carbon is in the range from 4:1 to 2:1.
6. Method of foaming of stainless steel slag, wherein FeSi, Al or Mg is added before calcium nitrate and carbon is added or injected into the slag by an injection gas.
7. Method according to claim 6, wherein air, nitrogen, carbon dioxide or inert gases are used as injection gases.
8. Use of calcium nitrate as a foaming agent for steel-making slags.

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Published:

- With international search report.
- Before the expiration of the time limit for amending the
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For two-letter codes and other abbreviations, refer to the "Guidance
Notes on Codes and Abbreviations" appearing at the beginning
of each regular issue of the PCT Gazette.

(54) Title: METHOD AND USE OF CALCIUM NITRATE FOR FOAMING OF STEEL-MAKING SLAGS

(57) Abstract: The invention concerns a method of foaming steel-making slags, wherein calcium nitrate is added to the slag alone or together with carbon. Calcium nitrate and carbon can be fed into the slag trough chutes or trough lances with injection gases such as air, nitrogen, carbon dioxide or inert gases. The solid components can be injected separately or with the same lance as a mixture or injected as pre-fused granules. For ladle slag foaming, calcium nitrate and carbon is added from above the melt. It is preferred to use a ratio between calcium nitrate and carbon in the range from 4.1 to 2:1. For foaming of stainless steel slag, it is preferred to add FeSi, Al or Mg before calcium nitrate and carbon is added or injected into the slag by an injection gas. Air, nitrogen, carbon dioxide or inert gases can be used as injection gas. The invention also concerns the use of calcium nitrate as a foaming agent for steel-makings slags. The invention can be used for slag foaming in electric arc furnaces and ladles.

WO 01/29271 A1

DECLARATION AND POWER OF ATTORNEY FOR U.S. PATENT APPLICATION

() Original () Supplemental () Substitute (X) PCT () DESIGN

As a below named inventor, I hereby declare that: my residence, post office address and citizenship are as stated below next to my name; that I verily believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural inventors are named below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

Title: METHOD AND USE OF CALCIUM NITRATE FOR FOAMING OF STEEL-MAKING SLAGS

of which is described and claimed in:

() the attached specification, or
 () the specification in application Serial No. _____, filed _____, and with amendments through _____, or
 (X) the specification in International Application No. PCT/NO00/00345, filed October 18, 2000, and as amended on _____ (if applicable).

I hereby state that I have reviewed and understand the content of the above-identified specification, including the claims, as amended by any amendment(s) referred to above.

I acknowledge my duty to disclose to the Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, §1.56.

I hereby claim priority benefits under Title 35, United States Code, §119 (and §172 if this application is for a Design) of any application(s) for patent or inventor's certificate listed below and have also identified below any application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

COUNTRY	APPLICATION NO.	DATE OF FILING	PRIORITY CLAIMED
Norway	19995072	October 18, 1999	Yes

I hereby claim the benefit under Title 35, United States Code §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code §112, I acknowledge the duty to disclose information material to patentability as defined in Title 37, Code of Federal Regulations, §1.56 which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

APPLICATION SERIAL NO.	U.S. FILING DATE	STATUS: PATENTED, PENDING, ABANDONED

And I hereby appoint Michael R. Davis, Reg. No. 25,134; Matthew M. Jacob, Reg. No. 25,154; Warren M. Check, Jr., Reg. No. 33,367; Nils Pedersen, Reg. No. 33,145; Charles R. Watts, Reg. No. 33,142; and Michael S. Huppert, Reg. No. 40,268, who together constitute the firm of WENDEROTH, LIND & PONACK, L.L.P., as well as any other attorneys and agents associated with Customer No. 000513, to prosecute this application and to transact all business in the U.S. Patent and Trademark Office connected therewith.

I hereby authorize the U.S. attorneys and agents named herein to accept and follow instructions from NORSK HYDRO ASA as to any action to be taken in the U.S. Patent and Trademark Office regarding this application without direct communication between the U.S. attorneys and myself. In the event of a change in the persons from whom instructions may be taken, the U.S. attorneys named herein will be so notified by me.

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I further declare that all statements made herein of my own knowledge are true, and that all statements on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

1st Inventor Petter Tuvnes Date 17 April 2002
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The above application may be more particularly identified as follows:

U.S. Application Serial No. _____ Filing Date March 29, 2002

Applicant Reference Number P99078 EAn:ELS Atty Docket No. 2002-0441A

Title of Invention METHOD AND USE OF CALCIUM NITRATE FOR FOAMING OF STEEL-MAKING SLAGS